The traffic accident reduction measures by climbing lane in Meishin Expressway

Koichi MATSUMOTO
Ibaraki Operation Office, Kansai Head Office,
West Nippon Expressway Company Limited
4-10-1 Kamihozumi Ibarakishi, Osaka, 567-0036, JAPAN
k.matsumoto.aa@w-nexco.co.jp

Aimi MOROOKA
Ibaraki Operation Office, Kansai Head Office,
West Nippon Expressway Company Limited

Sihyeong AN
West Nippon Expressway Engineering Kansai Co., Ltd.

ABSTRACT

The 6-lanes section between Oyamazaki IC and Ibaraki IC in Meishin Expressway is an eminent heavy traffic section in Japan, traffic volume is 126,000 cars per a day.
Recently, in the neighboring of Takatsuki-Bus-Stop on the side for Osaka in this section, the occurrence of traffic accident is remarkable, and it is necessary to take traffic accident reduction measures immediately.
We analyzed the cause of the traffic accident in Takatsuki-Bus-Stop area.
In there, a lot of congestion due to road structure called sag occurs, and many of traffic accidents are rear-end collision in congestion queue or at the end of congestion queue.
Particularly, many of the rear-end collision occur in passing lane.
By our study, it was become clear that occurrence of the traffic accident have much to do with congestion.
We proposed that it is effective accident prevention measures to increase the road capacity by installing climbing lane.

1. INTRODUCTION

The Meishin Expressway opened in July 1963 as the first expressway in Japan and has marked the 46th anniversary of the opening this year. Since the opening, it has greatly contributed to the Japanese economy development as the main transportation artery linking eastern and western Japan. The annual mean daily traffic within the six-lane section between the Oyamazaki IC and the Ibaraki IC exceeded 126,000 vehicles in 2008, and thereby this section has become one of the most heavy-trafficked

sections of expressways in Japan.

An area near the Takatsuki BS located on the down lane (the side for Osaka) in the relevant section has a sag road construction (of -4.6% to +4.0%), where is a common site of traffic jams and accidents. Due to an increase in traffic in the relevant section after the Shin-Meishin Expressway was put in service in February 2008, the number of traffic jams and that of traffic accidents are both further increasing. Under these circumstances, it has been anticipated to implement immediate measures for the prevention of traffic accidents.

We hereby make a report on the measures for the prevention of traffic accidents that we implemented by installing a climbing lane.

Photo-1 Down lane at Takatsuki BS

Photo-2 Traffic jam at Takatsuki BS

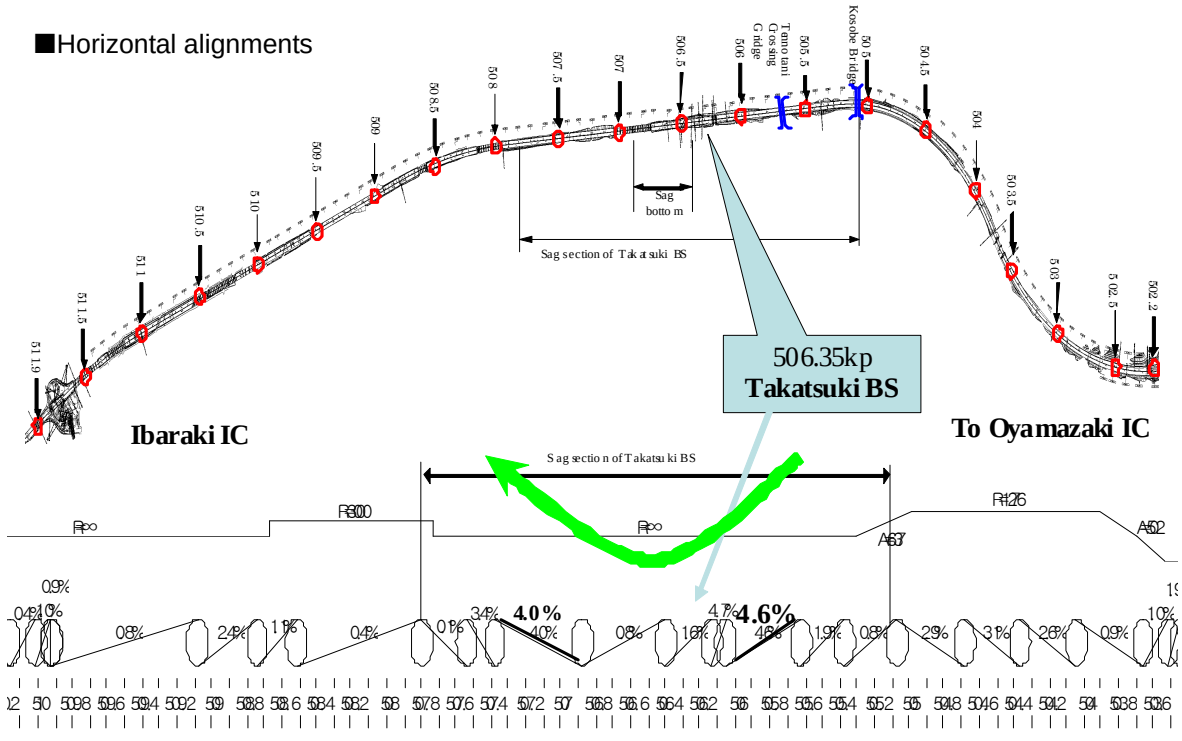


Fig-1 Road alignments around Takatsuki BS

2. TRAFFIC SITUATION IN THE NEIGHBORING OF TAKATSUKI-BUS-STOP

2-1. Traffic jam occurrence situation

Regarding the situation of traffic jams that occurred from the area on the down lane (the side for Osaka) of the Meishin Expressway in the neighboring of Takatsuki-Bus-Stop, such traffic jams occurred 68 times in 2004, while the number of traffic jams sharply increased to 133 times in 2008. Furthermore, compared to the number of traffic jams that occurred on the up line (the side for Nagoya), traffic jams occurred on the down line approximately seven times as many as those on the up line on an average during the period of 2004 to 2008. (See Table-1)

Table-1 Traffic situation around Takatsuki BS

(1) Annual mean daily traffic (Vehicles/day)

	Up lane	Down lane	Total
2004	59,000	59,065	118,065
2005	61,198	61,151	122,349
2006	62,612	62,320	124,932
2007	62,704	62,450	125,154
2008	63,272	63,527	126,799

Mar. 30, '03	Keiji ByPass opened between Ogura IC to Kumiyama JCT Second Keihan Expressway opened between Oguraike IC and Hirakata-higashi IC
Aug. 8, '03	The entire portion of the Keiji ByPass opened. (Completed the root twinned with Meishin Expressway)
Feb. 23, '08	Shin-Meishin Expressway opened Kusatsutanakami IC and Kameyama JCT.

*Source for 2008: Quick estimation from Traffic Counter Data

(2) Number of traffic jams (Jams/year)

	Up lane	Down lane	Total	(Down / Up)
2004	10	68	78	
2005	15	97	122	
2006	20	110	130	* 7.22
2007	11	119	130	
2008	17	133	150	

*Mean value of the period of 2004 to 2008

*Traffic jams caused due to heavy inbound traffic

(3) Number of accidents (Accidents/year)

	Up lane	Down lane	Total	(Down / Up)
2004	4	14	18	
2005	3	20	23	
2006	15	58	73	* 3.45
2007	14	48	62	
2008	20	53	73	

*Mean value of the period of 2004 to 2008

*Accidents caused in the sag section of the Takatsuki BS

2-2. Traffic accident occurrence situation

Regarding the situation of traffic accidents caused in the neighboring of Takatsuki-Bus-Stop on the down lane of the Meishin Expressway, we analyzed 30 traffic accidents caused in the section between 505.5kp and 506.7kp during the year 2007. These accidents include three characteristics: Rear-end accidents acount for approximately 80% of the total, accidents related to traffic jams acount for approximately 70% of the total, and most of the accidents were caused on the passing lane. (See Fig-2)

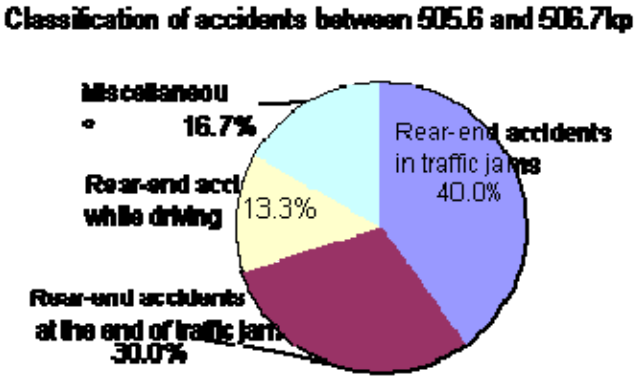


Fig-2 Classification of traffic accidents by pattern

Photo-3 Multiple rear-end accident

Regarding the situation of traffic accidents caused, rear-end accidents caused in traffic jams were relatively minor accidents. However, rear-end accidents caused at the end of traffic jam are more likely to multiple rear-end accidents involving a number of vehicles and highly likely to multiple fatal rear-end accidents occasionally. If a multiple rear-end accident occurs, the expressway will be closed to vehicles for an extended period of time, involving many customers in the closure and also raising concerns that another traffic jam starting from the accident site and secondary traffic accidents are caused. (See Photo-3)

Consequently, it has been required to implement urgent measures for the prevention of traffic accidents, that is, those for the prevention of traffic jams.

3. MEASURES FOR PREVENTION OF TRAFFIC ACCIDENTS BY INSTALLING CLIMBING LANE

Since traffic accidents related to traffic jams acount for 70% of the total, preventing traffic jams from being caused by sag construction is considered effective in preventing traffic accidents. The best preventive measure against traffic jams is to expand the traffic capacity of the relevant section, that is, to increase the number of traffic lanes from the current three lanes to four lanes. However, since adding just one traffic lane requires substantial reconstruction work, it is considered impractical as urgent measure. Under these circumstances, we made a study on the way to prevent traffic jams by installing a climbing lane as a measure that can be implemented without any change to the current total width of road.

3-1. Comparison of traffic by time zone (on up and down lanes)

Even though a comparison of peak hour traffic between the up lane and the down lane indicates approximately the same level, that is, a little less than 4,500 vehicles per hour, there are the fewer number of traffic jams and accidents on the up lane. The supposed reason is that a climbing lane has been built on the up lane since the opening of the expressway, and that the climbing lane has contributed to preventing traffic jams.

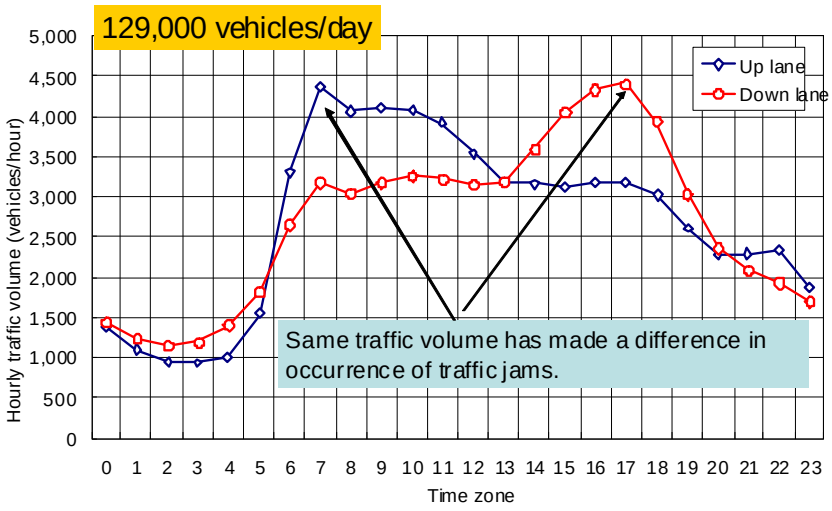


Fig.-3 Changes in hourly traffic volume between the up lane and the down lane

Photo-4 Up lane at Takatsuki BS

3-2. Analysis of climbing lane and its utilization rate

In order to identify differences in traffic situations and traffic jam occurrence situations between before and after building a climbing lane, we analyzed the relationship between traffic and climbing lane utilization rate.

A fixed traffic measurement system is installed at 506.1kp on the Meishin Expressway. However, since the system is located approximately 100 meters downstream from the starting point of the climbing lane on the up lane and further the climbing lane is just starting, data collected by this system remains not available to make a definite judgment on differences in lane utilization rates between the up lane and the down lane.

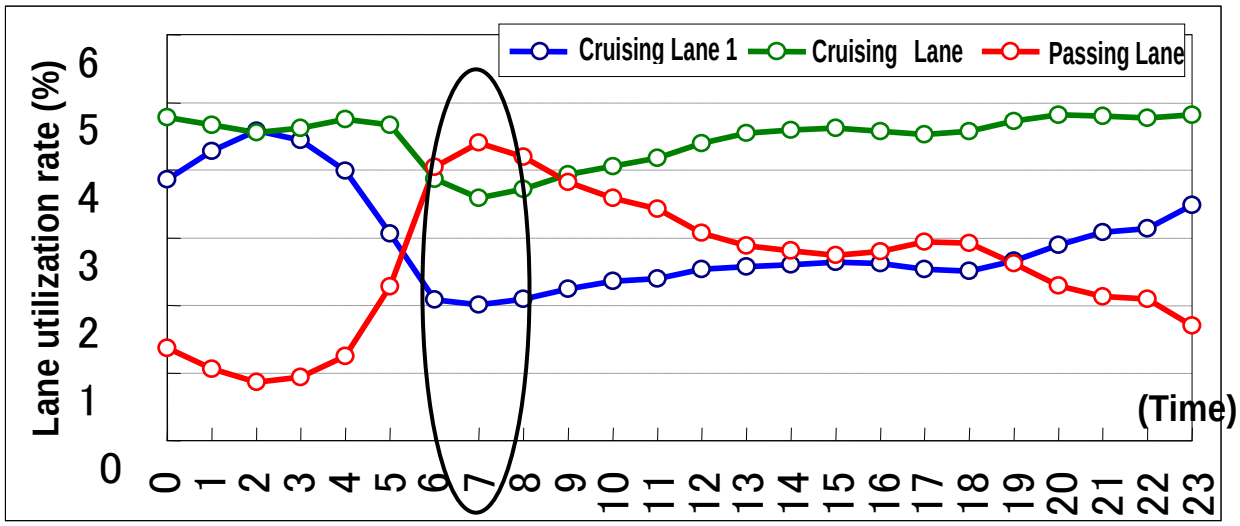
To identify changes in the lane utilization rates with the provision of the climbing lane, we analyzed data collected by fixed traffic measurement systems installed at two points located upstream from Nishinomiya-Najio SA on the down lane of the Chugoku Expressway (i.e., 21.05kp and 23.12kp) where a climbing lane is built in a six-lane section similar to the relevant section and no traffic jams are observed in such section.

Regarding the lane utilization rates at seven o'clock, at which peak hour traffic reaches approximately

4,500 at 21.05kp (located on the upstream from the starting point of the climbing lane with a longitudinal road alignment of 1.7%) and 23.12kp (located 400 meters downstream from the starting point of the climbing lane with a longitudinal road alignment of 4.0%), the utilization rate of the passing lane shows a 3%, declining from 44% to 41%, while that of the climbing lane come to 6%.

As a result, we think that, in the section with the climbing lane built, traffic jams on the passing lane has been successfully prevented without eventually causing traffic on the passing lane to exceed the traffic capacity by reducing traffic that had been unevenly distributed to the passing lane by 200 vehicles/hour (in other words, by reducing the lane utilization rate by approximately 5%) to make such reduced traffic change sequentially to the cruising lane 2, cruising lane 1, and then climbing lane.

21.05kp (located on the upstream from the starting point of the climbing lane)



23.12kp (located 400 meters downstream from the starting point of the climbing lane)

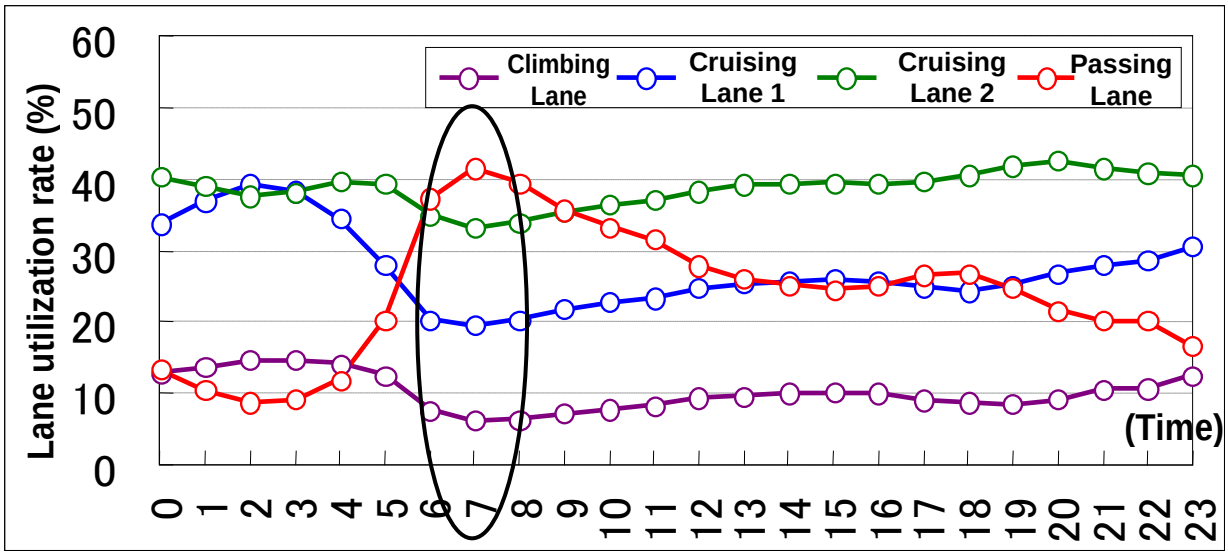
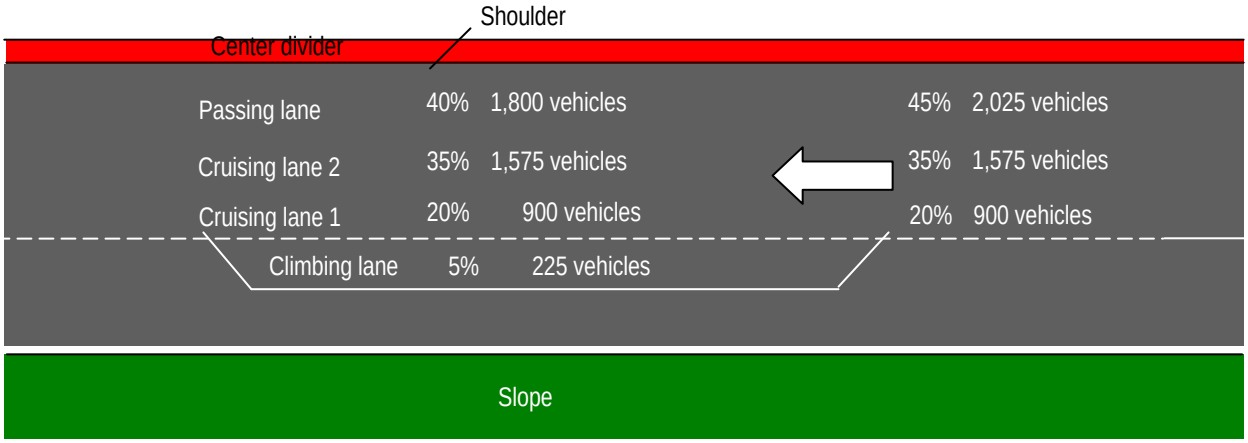


Fig.-4 Changes in lane utilization rates by time zone

Fig. 5 shows changes in lane utilization rates and traffic expected with provision of climbing lane. Assuming that peak hour traffic reaches 4,500 vehicles at the sag area in the relevant section when a

traffic jam occurs, we expect that such traffic jam within the section with climbing lane built can be prevented by reducing the traffic of 2,025 vehicles (the utilization rate of 45%) unevenly distributed on the passing lane to the traffic of 1,800 vehicles (the utilization rate of 40%, resulting in just an approximately 5% decline).

Consequently, we expect that reduction of traffic jams will achieve a 50% or more reduction of the current number of traffic accidents.



Peak hour traffic: 4,500 vehicles / hour

Fig.-5 Expected changes in lane utilization rates and traffic

4. STUDY ON STRUCTURE OF ROAD WIDTH

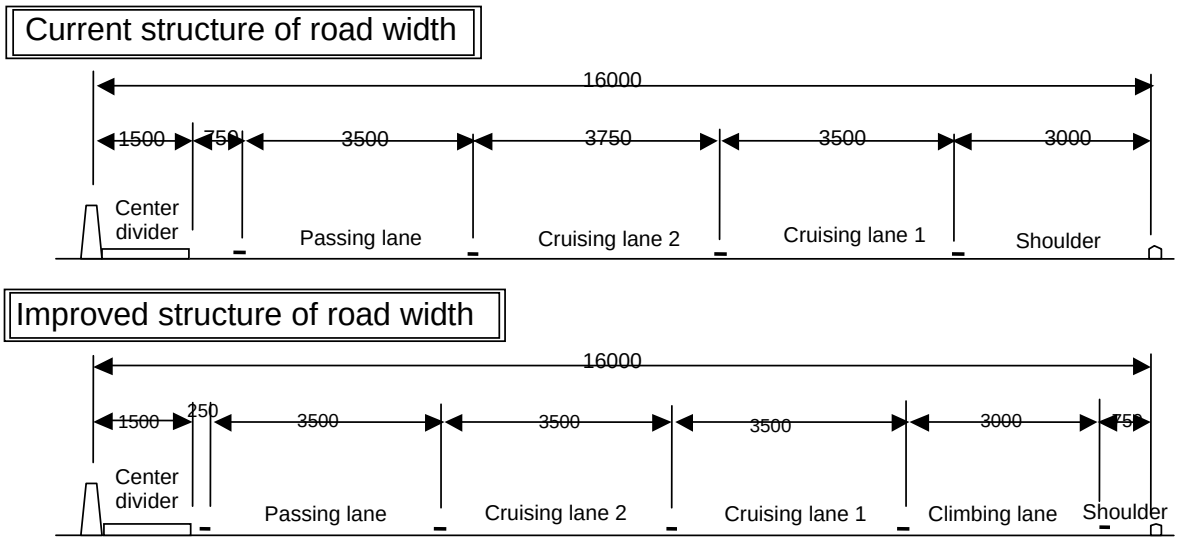


Fig.-6 Comparison of structures of road width

Since the relevant section of the Meishin Expressway falls under the road category of Type 1, Class 2 of the Road Standards, it is impossible to build climbing lane within the current full road width with the structure of road width meeting these Road Standards

However, we could installed the climbing lane without making any changes to the current full road

width by taking the structure of road width shown in Fig.-6 with the application of special values prescribed under the Road Structure Ordinance.

5. CONCLUSION

Since 70% of accidents caused in the relevant section were related to traffic jams, we made a study on installing a climbing lane for the sag area (the neighboring of Takatsuki-Bus-Stop) on the down lane of the Meishin Expressway to prevent traffic jams caused there by the sag construction as a measure for the prevention of traffic accidents.

For installing the climbing lane, we found out that it could be installed by applying the special values prescribed under the Road Structure Ordinance without making any changes to the current road width.

In addition, we expect that installing the climbing lane will be effective in eliminating traffic jams and further achieving a significant reduction in accidents caused during traffic jams.

Since the climbing lane as a measure for the prevention of traffic accidents at the sag area can be installed just by changing the division lines and shifting the lanes, this measure is considered implementable in a short period of time, most effective, and most economical as an urgent measure.